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## JOINT INSTITUTE FOR LABORATORY ASTROPHYSICS



UNIVERSITY OF COLORADO

### REPORT



NATIONAL BUREAU OF STANDARDS

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BIBLIOGRAPHY OF PHOTOABSORPTION CROSS SECTION DATA

by

R. D. Hudson

L. J. Kieffer

**JILA Information Center Report No. 11**

University of Colorado

Boulder, Colorado

September 30, 1970



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# JILA INFORMATION CENTER REPORT

No. 11

## BIBLIOGRAPHY OF PHOTOABSORPTION CROSS SECTION DATA

by

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# ABSTRACT

A bibliography of photoabsorption cross section data is presented. Only references which report a measured or calculated photoabsorption cross section (relative or normalized) in regions of continuous absorption are included. The bibliography is current as of January 1, 1970.

ADDITIONAL INFORMATION

## I. INTRODUCTION

In the past several years the Joint Institute for Laboratory Astrophysics Information Center,<sup>1</sup> University of Colorado, Boulder, Colorado, has been engaged in a program to collect reports that contain data on low energy atomic collisions, to critically evaluate and produce comprehensive compilations of these data, and to compile up-to-date bibliographies. The first bibliography on photoabsorption cross section data to be produced by the Information Center was published as JILA Information Center Report #5 in April, 1968.<sup>2</sup> This present report, the result of a collaborative effort between the Information Center and NASA-Manned Spacecraft Center, is the first updating of the original report.

Although the title of this report uses the term cross section we have, of course, included all papers that give absorption and ionization coefficients. The criterion that we have attempted to apply in our selection of the papers is that the data in the papers should be for wavelength regions of continuous absorption. For atoms, this clearly means those wavelength regions above the first ionization limit, indeed, until elastic scattering becomes important, the absorption and ionization continuum cross sections are identical. In the case of molecules this clear cut distinction cannot be made since we now have ionization and dissociation continua overlaid in many cases by discrete structure with variable efficiencies for preionization, predissociation and photoexcitation. We have therefore not restricted the wavelength range that was searched for data, but obviously the majority of the data are for the ultraviolet (10 to 3000 Å).

Several (about a dozen) standard works on photoabsorption and photoionization were used as primary sources for references. In addition, Physics Abstracts was searched back to 1940. The more current material was obtained from abstracting journals. The cutoff time for inclusion of references from these abstracting journals in this bibliography was March 1, 1970, but because of the time lag involved in the abstracting journals, some references to publications in the late part of 1969 may not be included. In addition to references from the formal scientific literature we have included theses, reports given at meetings, and company or agency reports which have been printed and circulated. However, reference is not made to material that is unavailable either through library facilities or government document centers. No classified material is included.

There is a tendency for authors to publish material which is identical to that which they have reported on at a meeting (the proceedings of which are printed and circulated) and also issued as a company or agency report. In some cases it is possible to verify that this is so and in those cases only one reference (the formal publication, if there is one) is kept in the bibliography. In most cases it is not possible to make such a precise distinction among such documents, since only some of the material may have been made available before. Because of this, there may be cases of duplication in the sense that there may be more than one

reference to the same original data. We have tried to keep this to a minimum consistent with our aim of collecting references to all published data.

Inclusion of a reference in this bibliography does not imply a value judgment about the accuracy of the information. We only assert that the reference reports a measured or calculated photoabsorption cross-section (or the equivalent). The question of the accuracy of the data is to be covered in separate published critical reviews (the first, on molecular photoabsorption cross section data, will be published soon by one of us, R.D.H.).

#### Description of the Bibliography Format

The Photoabsorption Cross Section Bibliography is divided into three main sections. The first section describes the data which are in the references included in the bibliography. The data are categorized by a hierarchy of descriptors in the following order:

1. Process (e.g., absorption, ionization, etc.)
2. Experimental or Theoretical
3. Normalized or Relative (The data are considered normalized if given in absolute units.)
4. Atomic or Molecular Species including the degree of ionization of the species. (A negative ion is indicated by a minus sign; neutral unexcited species by a blank; neutral excited species by a star; and a positive ion by a number indicating the degree of positive ionization. All of these symbols follow the atomic species, which are listed in ascending order of nuclear charge, Z. Molecular species are listed in arbitrary order.)
5. The references. These are identified by an arbitrary file number, the first author, and the year of publication (e.g., 63 implies 1963).

The Process categories that we have chosen are based more on experimental techniques than the, perhaps, more logical theoretical categories. Thus, for example, the category "Absorption" has no theoretical subsection, as the theoretical papers will deal specifically with ionization or dissociation. However, in the laboratory, the quantities measured are usually the total absorption cross section and the photoionization or photodissociation yield. In these cases the cross section is listed under "Absorption" while the yields are listed under "Ionization" and "Dissociation." This listing procedure has been followed even for papers which claim to measure "Ionization" cross sections for atoms using absorption techniques. Those papers listed under the category "Ionization, Experimental," have all measured the cross section by detecting the number of positive ions created.

A large amount of data is now becoming available using mass spectrometry and photoelectron techniques. These techniques measure a quantity which should yield the relative partial photoionization cross section

for the production of ion fragments, or of the parent ion in a particular energy state. We have listed the papers using these techniques under "Ionization, Relative."

The second section lists the title, authors and complete reference for the papers cited. These are ordered by their "file" number. The abbreviations for journal titles are taken from Chemical Abstracts.

The third section consists of an alphabetical author index. After each name is a list of the "file" numbers of articles, authored or co-authored, which can be found in the bibliographic section.

### Acknowledgments

We would like to gratefully acknowledge the assistance of the staff of the JILA Information Center in the preparation of this bibliography. The computer programs used were written by Patricia Ruttenberg, while the editorial and associated technical library work were performed by Elizabeth Reynolds and Victoria Tempey.

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<sup>1</sup> The JILA Information Center is supported in part by the National Bureau of Standards through the National Standard Reference Data Program.

<sup>2</sup> L. J. Kieffer, Bibliography of Photoabsorption Cross Section Data, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; Order Number PB189132.



## II. BIBLIOGRAPHY

1. *THE HISTORY OF THE UNITED STATES*

TOTAL ABSORPTION		EXPERIMENTAL	TOTAL ABSORPTION		EXPERIMENTAL
NORMALIZED			NORMALIZED		
H	1732 BEYNON,65	2026 BEYNON,66	CS	2666 BRADDICK,35	3067 MARR,68
HE	0308 KUYATT,64 0647 BAKER,61 1350 LOWRY,65 1359 CAIRNS,65 3005 HENKE,67 3685 DERSHEM,31	0509 AXELROD,59 1235 LEE,55 1351 MADDEN,65 2301 LUKIRSKII,64 3253 HENKE,67	PT	2874 WOLF,33	
LI	1353 HUDSON,65 2669 TUNSTEAD,53	2619 HUDSON,67 2704 BAKER,62	AU	2874 WOLF,33 3017 JAEGLE,66	3016 HAENSEL,68
BE	2705 PETERSON,63		TL	2480 MARR,54	2621 KOZLOV,66
C	3378 FOMICHEV,68		PB	3764 HEPPINSTALL,69	
N	1769 EHLER,55	2214 MORRIS,66	BI	3016 HAENSEL,68	3020 JAEGLE,67
O	1404 CAIRNS,65		TH	3293 BEZDENEZHNYKH,67	
NE	0308 KUYATT,64 1678 DITCHBURN,60 1826 WUILLEUMIER,65 2722 WUILLEUMIER,63 3005 HENKE,67 3685 DERSHEM,31	1226 LEE,53 1755 EDERER,64 2512 LEE,52 2898 WOERNLE,30 3253 HENKE,67	U	3293 BEZDENEZHNYKH,67	
NA	1377 BOTT,39 1739 DITCHBURN,53 2619 HUDSON,67	1719 DITCHBURN,50 2613 HUDSON,64 3004 HUDSON,68	H2	0688 COOK,63 1561 SAMSON,65 2026 BEYNON,66 2379 BUNCH,58 2770 WATANABE,53	1149 COOK,64 1756 EHLER,57 2319 LEE,52 2599 MESSNER,33 3257 CONES,68
MG	1740 DITCHBURN,53		O2	0508 WEISSLER,52 0641 MATSUNAGA,61 0916 COOK,64 1187 SAMSON,64 1252 COOK,64 1561 SAMSON,65 1641 CLARK,52 1749 DITCHBURN,62 1799 HUDSON,66 2313 LADENBURG,33 2318 LEE,55 2431 PRESTON,40 2638 WATANABE,52 2674 WATANABE,56 2718 THOMPSON,63 2770 WATANABE,53 2782 SROKA,67 2871 DITCHBURN,54 3005 HENKE,67 3376 GREINER,57 3573 OGANA,68 3685 DERSHEM,31	0622 WATANABE,58 0774 HUFFMAN,64 1131 HEILPERN,46 1234 WAINFAN,55 1280 METZGER,64 1612 ABOUD,55 1715 DITCHBURN,53 1797 GOLDSTEIN,66 1967 BLAKE,66 2314 LADENBURG,32 2384 MATSUNAGA,67 2599 MESSNER,33 2673 WATANABE,53 2688 KOSINSKAYA,65 2746 HUFFMAN,64 2778 DE REILHAC,64 2828 SROKA,65 2898 WOERNLE,30 3253 HENKE,67 3542 HUDSON,68 3638 WATANABE,58 3758 GAILY,69
AL	2621 KOZLOV,66		N2	0500 WEISSLER,52 0688 COOK,63 1187 SAMSON,64 1234 WAINFAN,55 1253 COOK,65 1641 CLARK,52 2599 MESSNER,33 2699 HUFFMAN,63 2746 HUFFMAN,64 2871 DITCHBURN,54 3005 HENKE,67 3376 GREINER,57 3784 HUDSON,69 3914 LUTZ,69	0636 ITAMOTO,61 0916 COOK,64 1232 CURTIS,54 1252 COOK,64 1561 SAMSON,65 2431 PRESTON,40 2674 WATANABE,56 2741 ASTOIN,57 2770 WATANABE,53 2898 WOERNLE,30 3253 HENKE,67 3685 DERSHEM,31 3833 SROKA,69
SI	2380 RICH,67		N2 *	2216 APPLETON,67	
SI *	2380 RICH,67		H2O	0688 COOK,63 1143 ASTOIN,56 1172 METZGER,64 1759 WILKINSON,50 2431 PRESTON,40 2677 WATANABE,53 2738 JOHANNIN-GILLES,55 2770 WATANABE,53 3755 SCHURGERS,68	1060 ASTOIN,57 1147 WATANABE,64 1619 ASTOIN,53 1821 LAUFER,65 2597 JOHANNIN-GILLES,53 2718 THOMPSON,63 2740 JOHANNIN-GILLES,56 2871 DITCHBURN,54
S	2898 WOERNLE,30		N H3	0605 THOMPSON,46 1172 METZGER,64 2604 SUN,55 2672 WATANABE,54 2770 WATANABE,53	0617 TANNENBAUM,53 2209 WATANABE,65 2671 WALKER,55 2718 THOMPSON,63
AR	0575 SAMSON,63 0870 RUSTGI,64 1355 METZGER,65 1826 WUILLEUMIER,65 2508 HUFFMAN,63 2722 WUILLEUMIER,63 2898 WOERNLE,30 3005 HENKE,67 3401 WHEATON,64 3685 DERSHEM,31	0691 HUFFMAN,63 1235 LEE,55 1359 CAIRNS,65 2301 LUKIRSKII,64 2703 LUKIRSKII,63 2857 PARRATT,39 2973 HUDSON,68 3253 HENKE,67 3402 BLACKWELL,64 3779 MADDEN,69	N O	0622 WATANABE,58 1371 ROMAND,52 2479 HARMO,53 2598 HAYENCE,52 2641 WATANABE,67 2675 WATANABE,53 2718 THOMPSON,63 2850 METZGER,63	1060 ASTOIN,57 2062 METZGER,67 2596 GRANIER,56 2605 SUN,55 2672 WATANABE,54 2683 WALKER,55 2770 WATANABE,53 2851 WATANABE,53
K	1228 DITCHBURN,43 1689 DITCHBURN,28 3067 MARR,68	1405 HUDSON,65 2862 HUDSON,67	C2H2	1172 METZGER,64 2375 MOE,52 2599 MESSNER,33	2342 SCHOEN,62 2482 NAKAYAMA,64 2682 WALKER,55
CA	1717 DITCHBURN,60 2310 JUTSUM,54 2697 HUDSON,67	1845 NEWSOM,66 2635 KELM,62	CL2	2844 JACOBS,65 3645 SEERY,64	2898 WOERNLE,30
CU	3016 HAENSEL,68		N2O	1060 ASTOIN,57 1220 ZELIKOFF,53 2610 ROMAND,49	1142 ASTOIN,55 2598 HAYENCE,52 2683 WALKER,55
ZN	3761 MARR,69				
GA	2867 STARTSEV,67	3337 KOZLOV,68			
KR	0575 SAMSON,63 1255 RUSTGI,64 2301 LUKIRSKII,64 2507 HUFFMAN,63 3253 HENKE,67 3685 DERSHEM,31	0691 HUFFMAN,63 1355 METZGER,65 2426 PERY-THORNE,60 3005 HENKE,67 3402 BLACKWELL,64			
RB	3067 MARR,68				
SR	3816 HUDSON,69				
AG	2874 WOLF,33	3016 HAENSEL,68			
CD	1293 ROSS,65	3765 MARR,69			
IN	1225 MARR,54 2961 MARR,66	2867 STARTSEV,67 3337 KOZLOV,68			
SN	3016 HAENSEL,68				
XE	0691 HUFFMAN,63 1355 METZGER,65 1777 LUKIRSKII,66 2508 HUFFMAN,63 2717 WATANABE,65 3005 HENKE,67 3346 SHARDANAND,68 3577 SHARDANAND,68	1255 RUSTGI,64 1360 MATSUNAGA,65 2301 LUKIRSKII,64 2687 WHITE,34 2872 DESLATTES,68 3253 HENKE,67 3402 BLACKWELL,64 3685 DERSHEM,31			
XE 1	2861 CAIRNS,62				
CS	1241 MOHLER,29	1242 BRADDICK,34			

TOTAL ABSORPTION		EXPERIMENTAL	TOTAL ABSORPTION		EXPERIMENTAL
NORMALIZED			NORMALIZED		
N20	2718 THOMPSON,63 2850 METZGER,63	2770 WATANABE,53 2864 COOK,68	C O S	2654 MATSUNAGA,67 3913 COOK,69	2850 METZGER,63
C O2	1042 NAKATA,65 1359 CAIRNS,65 1711 COOK,66 2252 INN,53 2599 MESSNER,33 2770 WATANABE,53 3685 OERSHEN,31	1245 SUN,55 1702 CAIRNS,66 1759 WILKINSON,50 2431 PRESTON,40 2718 THOMPSON,63 3533 HARWARD,68	C O4	1821 LAUFER,65	
C O	1245 SUN,55 1359 CAIRNS,65 1702 CAIRNS,66 2718 THOMPSON,63	1271 HUFFMAN,64 1626 COOK,65 2599 MESSNER,33 2770 WATANABE,53	LI CL	2625 DAVIDOVITS,67	
BR2	3012 SULZMANN,67	3645 SEERY,64	K CL	2625 DAVIDOVITS,67	
H CL	1393 ROMAND,48	2735 ROMAND,49	RB CL	2625 DAVIDOVITS,67	
C H4	0870 RUSTGI,64 1701 DITCHBURN,55 1821 LAUFER,65 2376 MOE,52 2604 SUN,55 2871 DITCHBURN,54	1172 METZGER,64 1759 WILKINSON,50 2301 LUKIRSKII,64 2599 MESSNER,33 2770 WATANABE,53 3914 LUTZ,69	CS CL	2625 DAVIDOVITS,67	
NA CL	2625 DAVIDOVITS,67		LI BR	2625 DAVIDOVITS,67	
H2S	1147 WATANABE,64 3005 HENKE,67	1855 LAVILLA,66 3253 HENKE,67	NA BR	2625 DAVIDOVITS,67	
C S2	2850 METZGER,63	3916 COOK,69	K BR	2625 DAVIDOVITS,67	
C CL4	2898 WOERNLE,30 3253 HENKE,67	3005 HENKE,67	RB BR	2625 DAVIDOVITS,67	
O2	1149 COOK,64		CS BR	2625 DAVIDOVITS,67	
C2H4	1172 METZGER,64 1759 WILKINSON,50 2342 SCHOEN,62 2682 WALKER,55	1229 ZELIKOFF,53 2121 WILKINSON,55 2599 MESSNER,33 3544 PERSON,68	LI I	2625 DAVIDOVITS,67	
XE2	3346 SHARDANAND,68	3577 SHARDANAND,68	NA I	2625 DAVIDOVITS,67	
C2H6	1172 METZGER,64 2599 MESSNER,33 3253 HENKE,67	2342 SCHOEN,62 3005 HENKE,67	K I	2625 DAVIDOVITS,67	
S F6	1854 CODLING,66 2663 ZINKINA,67	1855 LAVILLA,66	RB I	2625 DAVIDOVITS,67	
N O2	0622 WATANABE,58 2244 HALL,52	1328 NAKAYAMA,59 3295 LENZI,68	CS I	2625 DAVIDOVITS,67	
H I	2735 ROMAND,49	3912 HUEBERT,68	N204	2244 HALL,52	
S O2	2636 GOLOMB,62 2718 THOMPSON,63	2637 WARNECK,64 2898 WOERNLE,30	C302	2692 ROEBBER,67	
H BR	2735 ROMAND,49	3912 HUEBERT,68	C2F6	3005 HENKE,67	3253 HENKE,67
I CL	3645 SEERY,64		N O CL	3295 LENZI,68	
I BR	3645 SEERY,64		BR CL	3645 SEERY,64	
H2O2	2707 HOLT,48	3755 SCHURGERS,68	N2H4	3755 SCHURGERS,68	
SI O	3386 MAIN,68		N C N3	3919 OKABE,69	
C F4	1395 COOK,65	2376 MOE,52	H N3	3509 OKABE,68	
O3	0862 VASSEY,48 1369 NY,33 2423 OGAWA,58 2668 TANAKA,53 2700 VIGROUX,52 2702 VIGROUX,52 2734 VIGROUX,53 2889 VIGROUX,50 3508 GRIGGS,68	1368 VIGROUX,52 1430 VIGROUX,48 2633 INN,53 2688 HEARN,61 2701 VIGROUX,52 2723 VIGROUX,50 2770 WATANABE,53 2890 NY,32	RELATIVE		
N F3	2801 LA PAGLIA,61		BE	3398 SWANSON,68	
NA2	1394 HUDSON,65	2613 HUDSON,64	NE	2381 CODLING,67	
CS2	1707 LAPP,66	3399 CREEK,68	NA	2245 HARRISON,24	2246 HARRISON,25
C2O4	2121 WILKINSON,55	3544 PERSON,68	AR	0577 SCHNOPPER,63	3566 NAKAHURA,68
D2O	1060 ASTOIN,57 2732 JOHANNIN-GILLES,55	1821 LAUFER,65 2738 JOHANNIN-GILLES,55	SR	2490 GARTON,68	
K2	1228 DITCHBURN,43 1707 LAPP,66	1405 HUDSON,65 3399 CREEK,68	XE	3688 HAENSEL,69	
R82	3399 CREEK,68		CS	1238 MOHLER,26	
			H2	2485 COMES,67	
			H2O	1754 PATCH,65	
			C O2	0691 HUFFMAN,63	
			C H4	3532 CHUN,68	
			NA CL	3247 HAENSEL,68	
			AR2	2970 WILKINSON,68	
			O3	1370 VIGROUX,52	2511 BARBIER,42
			NA2	2246 HARRISON,25	
			NA BR	3247 HAENSEL,68	
			NA I	3247 HAENSEL,68	
			NA F	3247 HAENSEL,68	
			BE O	3398 SWANSON,68	
			GE F2	3918 HAUGE,68	

DETACHMENT		EXPERIMENTAL	IONIZATION		EXPERIMENTAL
NORMALIZED			NORMALIZED		
H -	1222 SMITH,59 1291 BOHM,65	1223 SMITH,59	H.	2855 BEYNON,65	
C -	0599 SEMAN,62	1008 BRANSCOMB,61	HE	1188 SAMSON,64	
O -	0038 BRANSCOMB,58 1632 BRANSCOMB,65	1628 BRANSCOMB,65 2667 SMITH,60	N	2942 COMES,68	
F -	0949 BERRY,63	2644 POPP,67	O	2943 COMES,68	
CL -	3780 ROTHE,69		NE	0926 COMES,64 1562 SAMSON,65	1226 LEE,53
BR -	3780 ROTHE,69		AR	0575 SAMSON,63 0993 SAMSON,64 1355 METZGER,65	0926 COMES,64 1234 MAINFAN,55
I -	0817 STEINER,62 3780 ROTHE,69	3414 STEINER,68	AR *	1835 ASINOVSKII,65	
O2 -	0468 BURCH,58	1628 BRANSCOMB,65	KR	0575 SAMSON,63	1355 METZGER,65
O H -	1628 BRANSCOMB,65	1669 BRANSCOMB,66	XE	1179 EDERER,64 1355 METZGER,65	1189 SAMSON,64 1360 MATSUNAGA,65
N O2 -	1628 BRANSCOMB,65	3887 WARNECK,69	CS	1382 COOKE,31 2320 LITTLE,27	2312 KUNZ,34
O D -	1628 BRANSCOMB,65	1669 BRANSCOMB,66	H2	0688 COOK,63 1234 MAINFAN,55	1149 COOK,64 3257 COMES,68
S H -	3548 STEINER,68		O2	0582 BLAKE,67 1187 SAMSON,64 1252 COOK,64 1798 SAMSON,66 2674 WATANABE,56	0916 COOK,64 1234 MAINFAN,55 1731 BLAKE,65 2384 MATSUNAGA,67
RELATIVE			N2	0582 BLAKE,67 0916 COOK,64 1234 MAINFAN,55 3379 JUDGE,68	0688 COOK,63 1187 SAMSON,64 1253 COOK,65
H -	0979 SMITH,55	1386 BRANSCOMB,55	H2O	0582 BLAKE,67 1147 WATANABE,64 1234 MAINFAN,55	0688 COOK,63 1172 METZGER,64
O -	0979 SMITH,55		N H3	1172 METZGER,64 2671 WALKER,55 2676 WATANABE,57	2209 WATANABE,65 2672 WATANABE,54
I -	0839 STEINER,63		N O	2062 METZGER,67 2675 WATANABE,53 2850 METZGER,63	2672 WATANABE,54 2683 WALKER,55
D -	1386 BRANSCOMB,55		C2H2	1172 METZGER,64 2482 NAKAYAMA,64	2342 SCHOEN,62 2682 WALKER,55
H302 -	3564 GOLUB,68		N2O	2683 WALKER,55 2864 COOK,68	2850 METZGER,63
			C O2	1042 NAKATA,65 1359 CAIRNS,65	1234 MAINFAN,55 1711 COOK,66
			C O	1359 CAIRNS,65	1626 COOK,65
			C H4	1172 METZGER,64	1234 MAINFAN,55
			H2S	1147 WATANABE,64	
			C S2	2850 METZGER,63	3916 COOK,69
			O2	1149 COOK,64	
			C2H4	1172 METZGER,64 2682 WALKER,55	2342 SCHOEN,62 3544 PERSON,68
			C2H6	1172 METZGER,64	2342 SCHOEN,62
			N O2	1328 NAKAYAMA,59	2850 METZGER,63
			S O2	2636 GOLOMB,62	
			C F4	1395 COOK,65	
			C2O4	3544 PERSON,68	
			C O S	2654 MATSUNAGA,67 3913 COOK,69	2850 METZGER,63
			RELATIVE		
			HE	2622 CARLSON,67 3694 SAMSON,69	2678 WEISSLER,59
			N	0528 COMES,67	
			NE	2622 CARLSON,67 3413 SAMSON,68	2678 WEISSLER,59
			AR	1883 VILLAREJO,67	2600 SCHONHEIT,61





IONIZATION		THEORETICAL		IONIZATION		THEORETICAL	
NORMALIZED				NORMALIZED			
LI	0842 TAIT,64 2056 BURGESS,60 2378 MOSKVIN,63 2608 STEWART,54 2728 SEWELL,67 2848 MCGUIRE,65 3523 CHANG,68	1288 MCGUIRE,67 2218 CHIU,67 2478 HARGREAVES,29 2649 PEACH,67 2748 YAAKOBI,67 3520 MCGUIRE,68 3890 GEZALOV,68		NA	1 1236 BATES,46		
LI	1 2217 BELL,67 2649 PEACH,67 3890 GEZALOV,68	2607 STEWART,63 2681 ZHIRNOV,62		MG	2652 PEACH,62 3520 MCGUIRE,68	2856 ALTICK,64	
BE	1236 BATES,46 2999 ALTICK,68	2856 ALTICK,64 3520 MCGUIRE,68		MG	1 2056 BURGESS,60		
B	1321 BATES,39 2829 VAINSHTEIN,53	2742 VAINSHTEIN,54 3520 MCGUIRE,68		AL	2652 PEACH,62 2843 MANSON,68	2670 VAINSHTEIN,60 3520 MCGUIRE,68	
C	1321 BATES,39 2359 PRADERIE,64 2742 VAINSHTEIN,54 3520 MCGUIRE,68	1624 BATES,49 2429 PRADERIE,64 2829 VAINSHTEIN,53		SI	2868 CONNEELY,67	3520 MCGUIRE,68	
C *	0578 NORMAN,63			SI	1 2056 BURGESS,60		
C	1 1236 BATES,46			P	3520 MCGUIRE,68		
C	2 3390 HIDALGO,68			S	3520 MCGUIRE,68		
C	3 3390 HIDALGO,68			CL	0741 WOO,47	3520 MCGUIRE,68	
C	4 3390 HIDALGO,68			AR	0741 WOO,47 1660 DALGARNO,52 2843 MANSON,68 3520 MCGUIRE,68 3884 MENDEZ,68	0925 COOPER,62 2506 COOPER,64 2868 CONNEELY,67 3766 AMUSIA,69	
N	1321 BATES,39 1661 DALGARNO,60 1733 BREENE,65 2652 PEACH,62 2829 VAINSHTEIN,53 3520 MCGUIRE,68	1624 BATES,49 1667 DALGARNO,60 1830 HENRY,66 2742 VAINSHTEIN,54 3213 HENRY,68		K	1193 BATES,47 2056 BURGESS,60 2428 PHILLIPS,32 2848 MCGUIRE,65	1288 MCGUIRE,67 2378 MOSKVIN,63 2602 SEATON,51 3520 MCGUIRE,68	
N *	0578 NORMAN,63			K	1 1219 SEATON,50		
N	1 1211 JOHNSTON,64 3879 HENRY,68	1236 BATES,46		CA	1330 BATES,40 2601 SEATON,55 2856 ALTICK,64	2221 MOORES,66 2742 VAINSHTEIN,54 3520 MCGUIRE,68	
N	2 3390 HIDALGO,68			CA	1 1330 BATES,40 2242 GREEN,49	2056 BURGESS,60 2243 GREEN,50	
N	3 3390 HIDALGO,68			SC	3520 MCGUIRE,68		
N	4 1627 IVANOVA,64	3390 HIDALGO,68		YI	3520 MCGUIRE,68		
O	0690 DALGARNO,64 1321 BATES,39 1661 DALGARNO,60 1733 BREENE,65 2652 PEACH,62 2771 HENRY,67 2896 YAMANOUCHI,40 3703 HENRY,68	0741 WOO,47 1624 BATES,49 1667 DALGARNO,60 2056 BURGESS,60 2742 VAINSHTEIN,54 2894 STEWART,65 3520 MCGUIRE,68		V	3520 MCGUIRE,68		
O	1 1236 BATES,46 2895 YAMANOUCHI,42	1830 HENRY,66 3213 HENRY,68		CR	3520 MCGUIRE,68		
O	2 2891 YAMANOUCHI,41 3879 HENRY,68	3390 HIDALGO,68		MN	3520 MCGUIRE,68		
O	3 3390 HIDALGO,68			FE	3520 MCGUIRE,68		
O	4 3390 HIDALGO,68			CO	3520 MCGUIRE,68		
O	5 1627 IVANOVA,64			NI	3520 MCGUIRE,68		
F	1321 BATES,39	3520 MCGUIRE,68		CU	2843 MANSON,68		
F	1 1236 BATES,46			CU	1 0925 COOPER,62		
NE	0741 WOO,47 1218 SEATON,51 1337 SEWELL,65 2603 SEATON,54 3520 MCGUIRE,68	0925 COOPER,62 1321 BATES,39 2058 HENRY,67 2742 VAINSHTEIN,54		ZN	3520 MCGUIRE,68		
NE	1 1236 BATES,46 3879 HENRY,68	3390 HIDALGO,68		GA	2670 VAINSHTEIN,60	3520 MCGUIRE,68	
NE	2 3390 HIDALGO,68	3879 HENRY,68		GE	2843 MANSON,68	3520 MCGUIRE,68	
NE	3 3390 HIDALGO,68	3879 HENRY,68		AS	3520 MCGUIRE,68		
NE	4 3390 HIDALGO,68	3879 HENRY,68		SE	3520 MCGUIRE,68		
NA	0925 COOPER,62 1670 RUDKJOBING,40 2218 CHIU,67 2602 SEATON,51 2665 BOYD,64 2829 VAINSHTEIN,53 2848 MCGUIRE,65	1288 MCGUIRE,67 2056 BURGESS,60 2378 MOSKVIN,63 2649 PEACH,67 2742 VAINSHTEIN,54 2843 MANSON,68 3520 MCGUIRE,68		BR	3520 MCGUIRE,68		
				KR	0741 WOO,47 1288 MCGUIRE,67 2848 MCGUIRE,65 3520 MCGUIRE,68	0925 COOPER,62 2843 MANSON,68 2941 COMES,68 3708 COOPER,69	
				RB	1288 MCGUIRE,67 2378 MOSKVIN,63 2848 MCGUIRE,65	1903 FARNoux,67 2602 SEATON,51 3520 MCGUIRE,68	
				SR	2856 ALTICK,64	3520 MCGUIRE,68	
				Y	3520 MCGUIRE,68		
				ZR	3520 MCGUIRE,68		
				NB	3520 MCGUIRE,68		
				MO	3520 MCGUIRE,68		
				TC	3520 MCGUIRE,68		
				RU	3520 MCGUIRE,68		
				RH	2843 MANSON,68	3520 MCGUIRE,68	
				PD	3520 MCGUIRE,68		

IONIZATION		THEORETICAL		DISSOCIATION		EXPERIMENTAL
NORMALIZED				RELATIVE		
AG	2845 MATESE,65	3520	MCGUIRE,68	H20	0772 BEYER,64	
AG	1 0925 COOPER,62			N H3	2853 OKABE,67	
CD	3520 MCGUIRE,68			N O	0772 BEYER,64	
IN	1288 MCGUIRE,67 2848 MCGUIRE,65	1893 MCGUIRE,65 3520 MCGUIRE,68		C O2	0772 BEYER,64	2727 DIBELER,67
SN	1288 MCGUIRE,67 2848 MCGUIRE,65	1903 FARNOUX,67 3520 MCGUIRE,68		H2S	3392 DIBELER,68	
SB	1288 MCGUIRE,67 2848 MCGUIRE,65	1893 MCGUIRE,65 3520 MCGUIRE,68		C S2	2727 DIBELER,67	
TE	1288 MCGUIRE,67 2848 MCGUIRE,65	1893 MCGUIRE,65 3520 MCGUIRE,68		S O2	3392 DIBELER,68	
I	1288 MCGUIRE,67 3520 MCGUIRE,68	2848 MCGUIRE,65		C O S	2727 DIBELER,67	
XE	0741 WOO,47 1893 MCGUIRE,65 2506 COOPER,64 2843 MANSON,68 2941 COMES,68	1288 MCGUIRE,67 2079 COMES,66 2618 BRANDT,67 2848 MCGUIRE,65 3520 MCGUIRE,68		DISSOCIATION		THEORETICAL
CS	1288 MCGUIRE,67 2602 SEATON,51	2378 MOSKVIN,63 2848 MCGUIRE,65		NORMALIZED		
EU	2843 MANSON,68			H2	3988 DALGARNO,69	
TA	1903 FARNOUX,67	3917 FARNOUX,69		H2	1 2800 OKSYUK,67 3259 DUNN,68	2876 DUNN,68
PT	3917 FARNOUX,69			O2	2606 STUECKELBERG,32	
AU	2686 FARNOUX,67 3917 FARNOUX,69	2843 MANSON,68		O2	1 2876 DUNN,68	3259 DUNN,68
HG	2845 MATESE,65			SCATTERING		EXPERIMENTAL
PB	2845 MATESE,65			RELATIVE		
BI	2686 FARNOUX,67	3917 FARNOUX,69		HE	2689 SHARDANAND,67	2875 WOLLAN,31
U	2845 MATESE,65			NE	2689 SHARDANAND,67	2875 WOLLAN,31
FM	2843 MANSON,68			AR	2689 SHARDANAND,67 2875 WOLLAN,31	2720 HEDDLE,62
H2	1599 FLANNERY,65 2869 KHARE,67 3891 KAPLAN,69	2057 SHIMIZU,63 3412 KHARE,68		KR	2720 HEDDLE,62	
H2	1 2204 BATES,53	3517 BATES,68		XE	2720 HEDDLE,62	
O2	3821 DIXON,69			H2	2689 SHARDANAND,67 2875 WOLLAN,31	2720 HEDDLE,62
N2	3889 SCHNEIDER,69			O2	2875 WOLLAN,31	
C2H2	3692 KAPLAN,68			N2	2689 SHARDANAND,67	2720 HEDDLE,62
C H4	1660 DALGARNO,52			SCATTERING		THEORETICAL
RELATIVE				NORMALIZED		
HE	2631 BYRON,67			H	0672 HIMMELL,67 3162 GAVRILA,66	2775 GAVRILA,67
KR	2645 KRAUSE,67			H *	2781 ZERNIK,64	
DISSOCIATION		EXPERIMENTAL		HE	2719 CHAN,65	2842 KIM,68
NORMALIZED				O	0741 WOO,47	
H2	2477 BEYER,67			NE	0741 WOO,47	
O2	1280 METZGER,64 2384 MATSUNAGA,67	1797 GOLDSTEIN,66		NA	2779 HEDDLE,64	
H20	2477 BEYER,67			CL	0741 WOO,47	
N H3	2477 BEYER,67			AR	0741 WOO,47	
C H4	1701 DITCHBURN,55			KR	0741 WOO,47	
P H3	1313 KLEY,65			XE	0741 WOO,47	
RELATIVE				PR	3 2963 KONINGSTEIN,68	
H2	0772 BEYER,64	2866 BERKOWITZ,67		TM	3 2963 KONINGSTEIN,68	
O2	0772 BEYER,64	2727 DIBELER,67		N2	2958 DALGARNO,67	

## EXPERIMENTAL

**NORMALIZED**

02 2943 CONES,68 3250 FROST,68  
3682 SAMSON,59

N2 3682 SAMSON, 59

C2H2 2342 SCHOEN,62

C 02 3682 SAMSON, 59

C2H4 2342 SCHOEN,62

C2H6 2342 SCHOEN,62

## RELATIVE

02 : 2678 WEISSLER,59                      3549 DOOLITTLE,68

N2      0931 COMES,64                      2678 WEISSLER,59

H20 2623 DIBELER,66

N H3 2623 DIBELER,66

N O 2678 WEISSLER, 59

C2H2 1684 BOTTER,66

N20      2678 WEISSLER,59      2873. DIBELER,67

C 02 2678 WEISSLER,59

C O 2678 WEISSLER, 59

BR2 2377 MORRISON,60

H CL 3640 KRAUSS, 68

C H4      1357 DIBELER,65      3026 CHUPKA,68

12 2377 MORRISON,60

C2H4	1699 BREHM,66	2025 BOTTER,66
	3757 CHUPKA,69	

N 02      2678 WEISSLER,59      2873 DIBELER,67

C H3CL      2219 DIBELER,65      3640 KRAUSS,68

C2N2 3011 DIBELER,67

H C N      3251 OIBELER,68      3691 BERKOWITZ,69

C H3F 3640 KRAUSS,68

C 04 1357 DIBEL ER,65

TE2 3886 BERKOWITZ,69

SE2 3886 BERKOWITZ,69

S2 3886 BERKOWITZ, 69

NA I 1979 BERKOWITZ, 66

TL I 1979 BERKOWITZ,66

NA212 1979 BERKOWITZ, 66

MG I2 1979 BERKOWITZ,66

HD CHD 2025 BOTTER,66

C2D2 1684 BOTTER,66

CL C N 3011 OIBELER,67

BR C N 3011 DIBELER,67

I C N 3011 DIBELER,67

F C N 3011 DIBELER,67

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